TERRESTRIAL ENERGY

Vision: Safe, secure and affordable nuclear energy for a clean and sustainable world

Mission: License and build a commercial molten salt reactor in the 2020s

May 2016

DISCLAIMER

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PRESENTATION TO NREL

8th June 2016

Golden, CO

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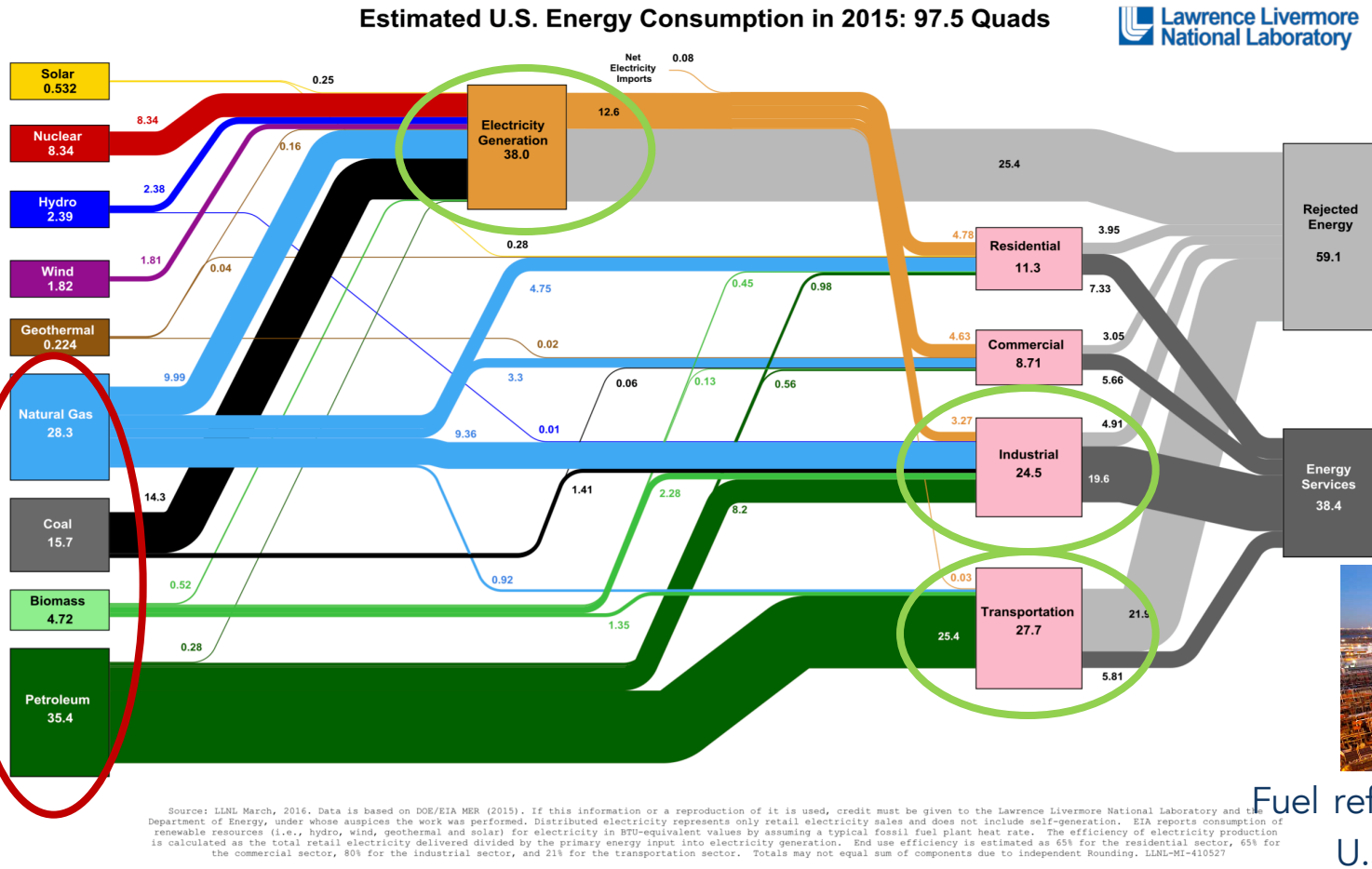
TERRESTRIAL ENERGY

THE TASK…A VERY HEAVY LIFT.



Industry produces ~20% of U.S. GHG emissions

Fuel refining produces~5% of U.S.GHG emissions

- U.S. DOE's strategic plan: Produce 80% of electricity from Clean Energy Sources by 2035
- U.S. Presidential Order 13693: Reduce direct GHG emissions by 40% by 2025
- Paris COP21: Aim of limiting Global Temperature rise to 2°C

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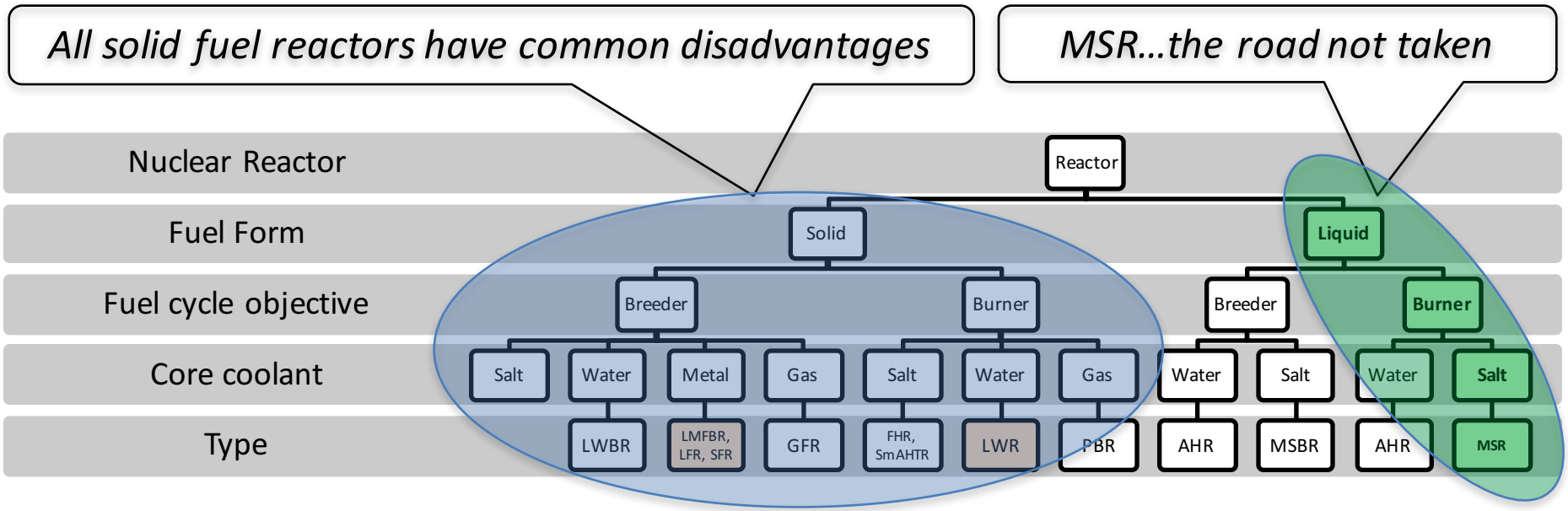
"NUCLEAR ENERGY" IS A RICH TAPESTRY

Liquid fuel, salt cooled burners offer unique competitive advantages



Today, the market factors driving reactor development are different:

- Cost innovation through passive safety
- Small modular reactors
- Grid and water independence

Now is the time to commercialize the MSR

TERRESTRIAL ENERGY

INTRODUCTION TO TERRESTRIAL ENERGY

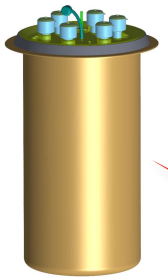
Terrestrial Energy

- Commercializing an Advanced Reactor technology
- Engaging with power utility industry and their senior executives, industrial companies, environmental community and G7 Governments

Technology – next generation Molten Salt Reactor ("MSR")

- Proprietary MSR design called the Integral Molten Salt Reactor ("IMSR™")
- High technology readiness for market deployment in the 2020s
- IMSR™ to compete with fossil fuels
- Commenced basic/preliminary engineering work

IMSR™ – INNOVATION FOR INDUSTRIAL USE



Key innovation is the integration of primary reactor components

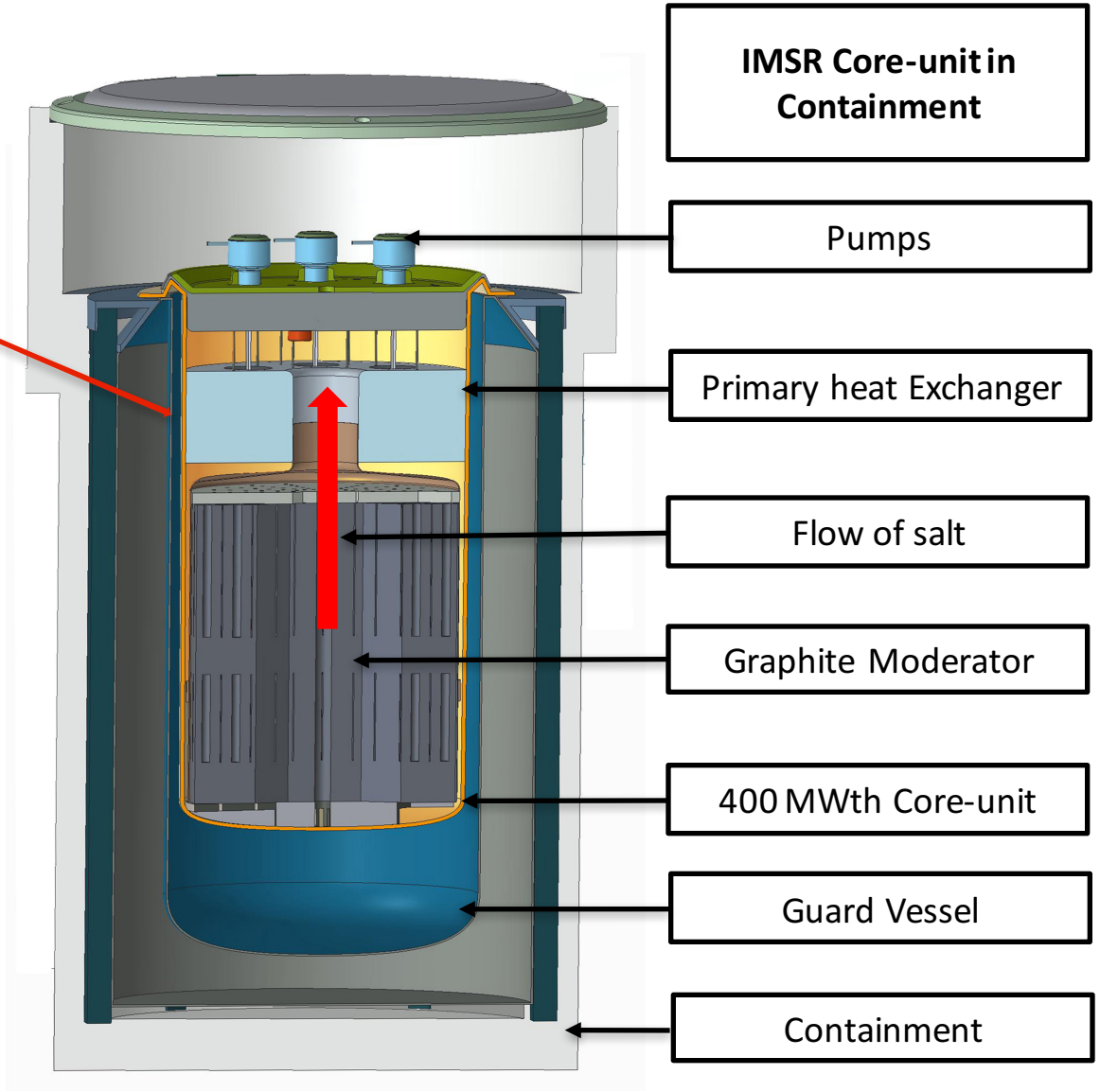
- Reactor core
- Primary heat exchanger
- Pumps

..into a sealed reactor vessel within a compact and replaceable unit

- For a 7-year operational life

This integral design promises high industrial value through

- Inherent safety
- Operational simplicity
- Cost innovation



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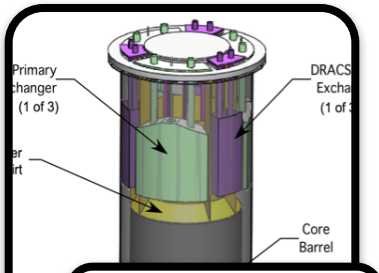
IMSR™ – TECHNOLOGY READINESS

IMSR™ builds on 50 years of ORNL reactor design work and relies on many demonstrated technologies.

IMSR™ is a molten salt reactor system that uses:

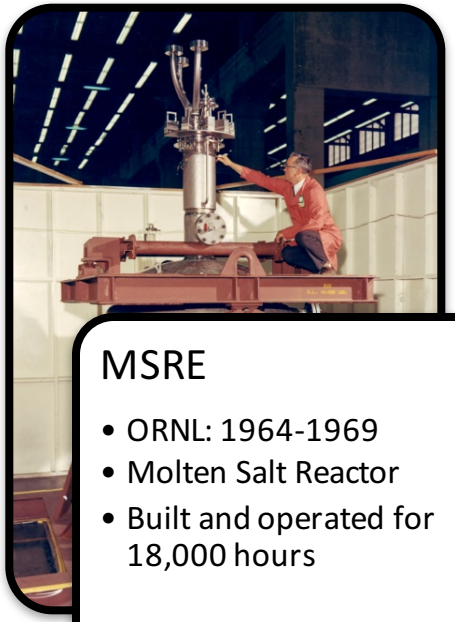
- Fluoride chemistry
- LEU once-through fuel cycle
- Thermal spectrum
- Graphite moderator
- Integral core architecture

Conclusion: IMSR™ has no remaining technology challenges



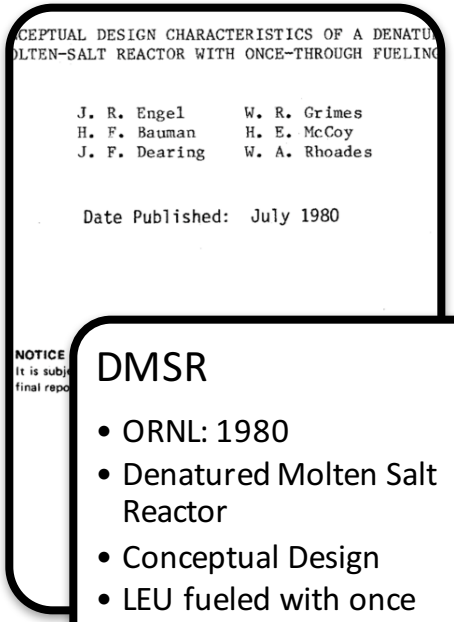
Sm-AHTR

- ORNL: 2010
- Pre-conceptual design
- Solid fueled - salt cooled
- Cartridge core design



MSRE

- ORNL: 1964-1969
- Molten Salt Reactor
- Built and operated for 18,000 hours


CEPTUAL DESIGN CHARACTERISTICS OF A DENATU
OLTEN-SALT REACTOR WITH ONCE-THROUGH FUELING

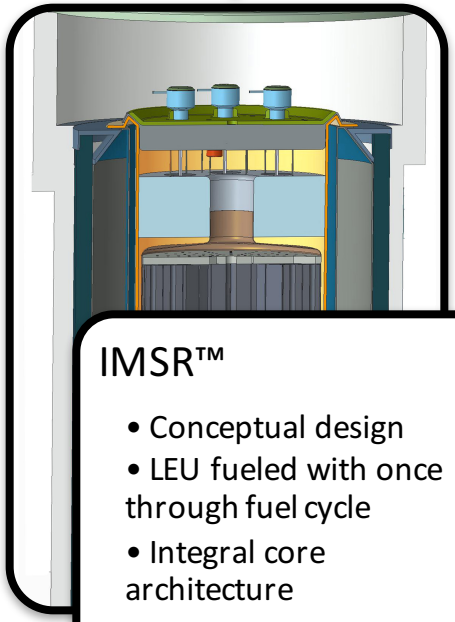
J. R. Engel W. R. Grimes
H. F. Bauman H. E. McCoy
J. F. Dearing W. A. Rhoades

Date Published: July 1980

NOTICE
It is subj
final repo

DMSR

- ORNL: 1980
- Denatured Molten Salt Reactor
- Conceptual Design
- LEU fueled with once through fuel cycle



IMSR™

- Conceptual design
- LEU fueled with once through fuel cycle
- Integral core architecture

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IMSR™ – NPP INNOVATION

Cost

- Potential IMSR BTUs and kWhs to be competitive with fossil fuels

Dispatchable

- IMSR™ has a strong ability to ramp

Industrial convenience

- An SMR, transportable, potential to be grid and water independent

Clean

- Carbon-free heat and power

Passive safety

- Supports cost innovation

IMSR™ promises to deliver clean (carbon-free), secure, scalable and economic industrial heat and power

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IMSR™ – SAFETY CASE

Central challenge for all reactor designers is heat dissipation in all circumstances

- Central pillar of Safety Case

IMSR™ assures heat dissipation in all circumstances

- Fuel is a liquid salt that is also the coolant
  - Convective cooling of fuel
- A small reactor (<600 MWth) that operates at 700 °C
  - Radiative cooling at a rate of 9x compared to 300 °C

IMSR™ dissipates heat through simple, natural and passive mechanisms

- No pumps or active cooling mechanisms necessary

No chemical driving forces

- Zirconium Metal-Water reactions absent

No physical driving forces

- Operates at one atmosphere

Strong negative reactivity coefficient of temperature

- Passive shutdown Safety Case

No "cliff" behavior in the IMSR's operating profile

IMSR™ Safety Case achieved with simple, natural and passive mechanisms that are secure and robust

FUNDAMENTAL RELATIONSHIP IN NPP ECONOMICS

$$\text{CAPEX} = f(\text{reactor system's Safety Case})$$

Safety Case drives:

- Cost to develop
- Cost to license
- Cost to construct

A reactor system's Safety Case drives CAPEX
IMSR™ has a Safety Case to drive cost innovation

IMSR™ IS A SMALL MODULAR REACTOR

SMRs are viewed as the most promising commercial formulation for new reactor systems

Value of the SMR is a function of the ability to incorporate modularity into the design to support:

- Manufacturing synergies
- Construction synergies

Reactor core size is a common constraining component

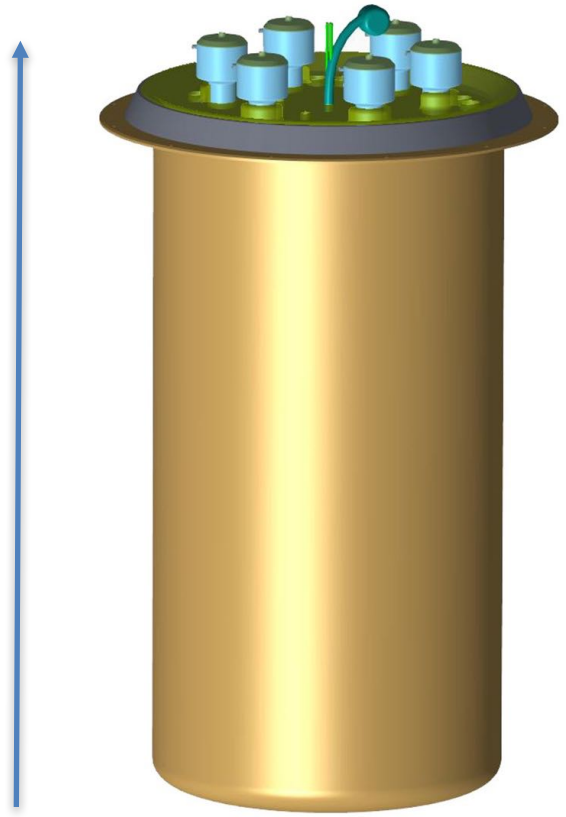
IMSR™ Core-unit

- Easily truck and rail transportable
- Does not require large single forged vessels for high pressure containment
- Simpler to manufacture

IMSR™ from the start designed for modularity

- A small modular and factory manufactured reactor
- Site assembled

IMSR™ Core-unit 8m tall



IMSR™ design with IMSR™ Core-unit ideal for the SMR market opportunity

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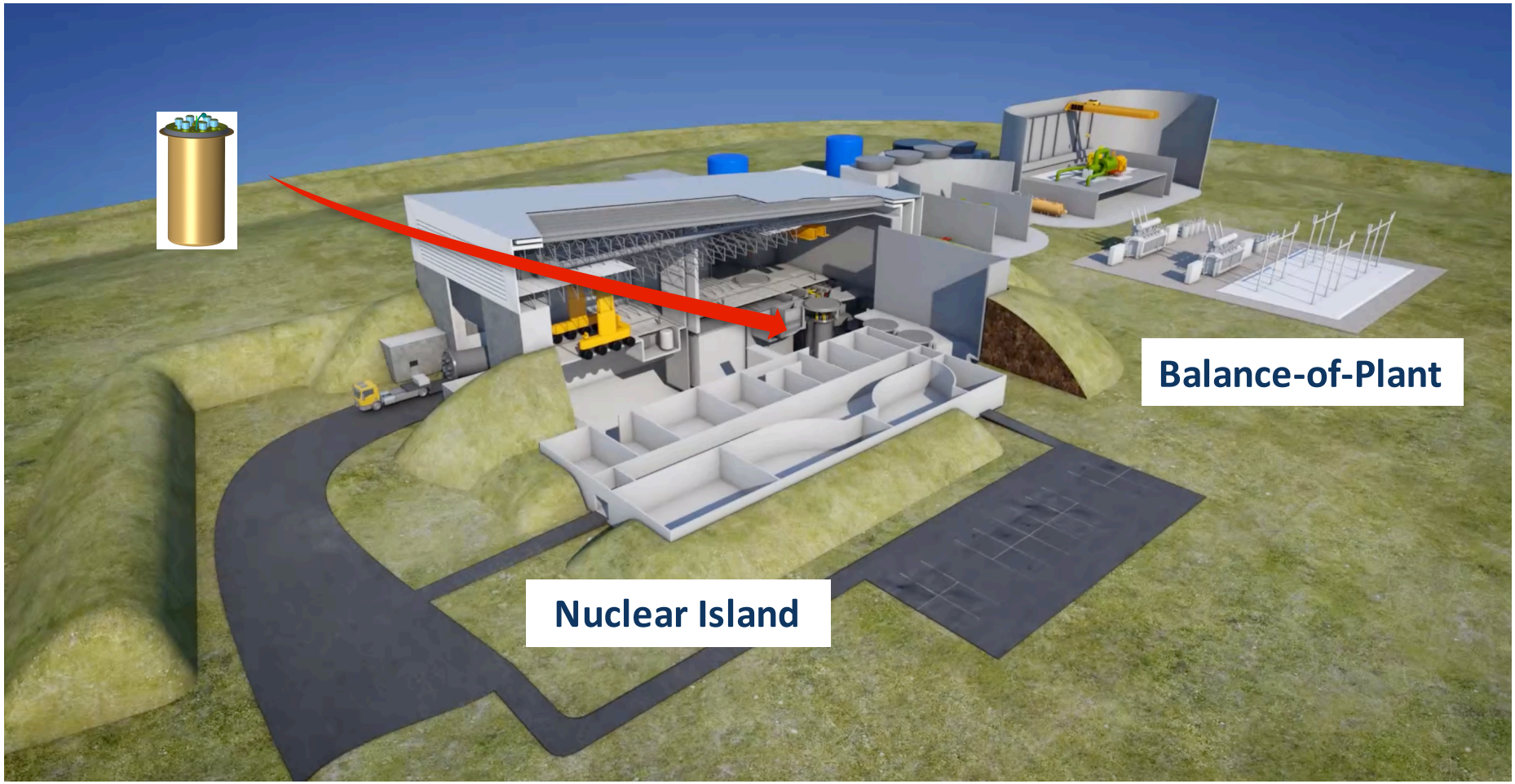
IMSR™ NPP CONSISTS OF NUCLEAR ISLAND AND BALANCE-OF-PLANT



IMSR™ Nuclear Island produces 600°C industrial heat. Balance-of-Plant can be a broad range of industrial applications – not just power provision

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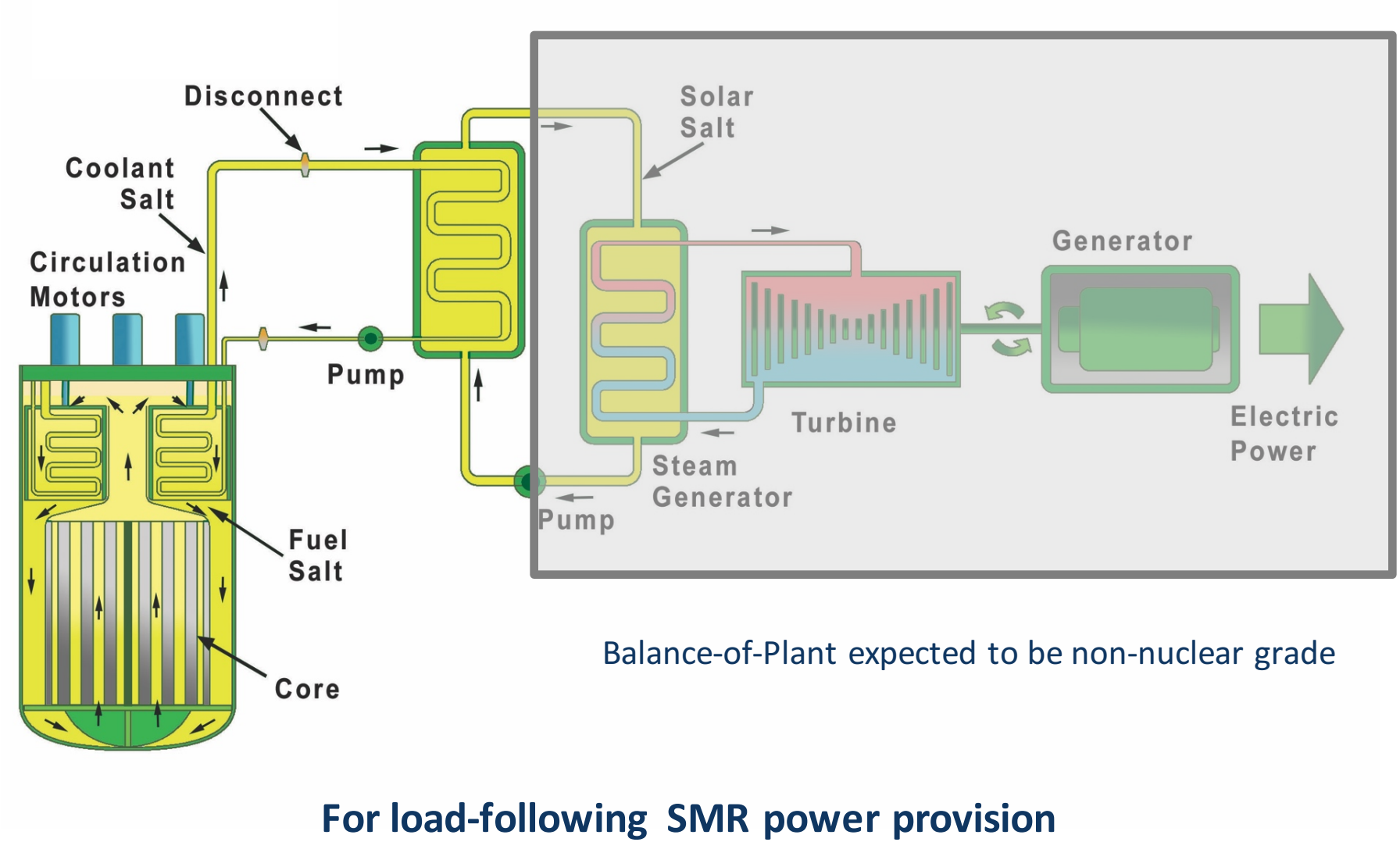
IMSR™ 400 MWth (190 MWe) GENERALIZED NPP FACILITY



Balance-of-Plant expected to be non-nuclear grade

For load-following SMR power provision

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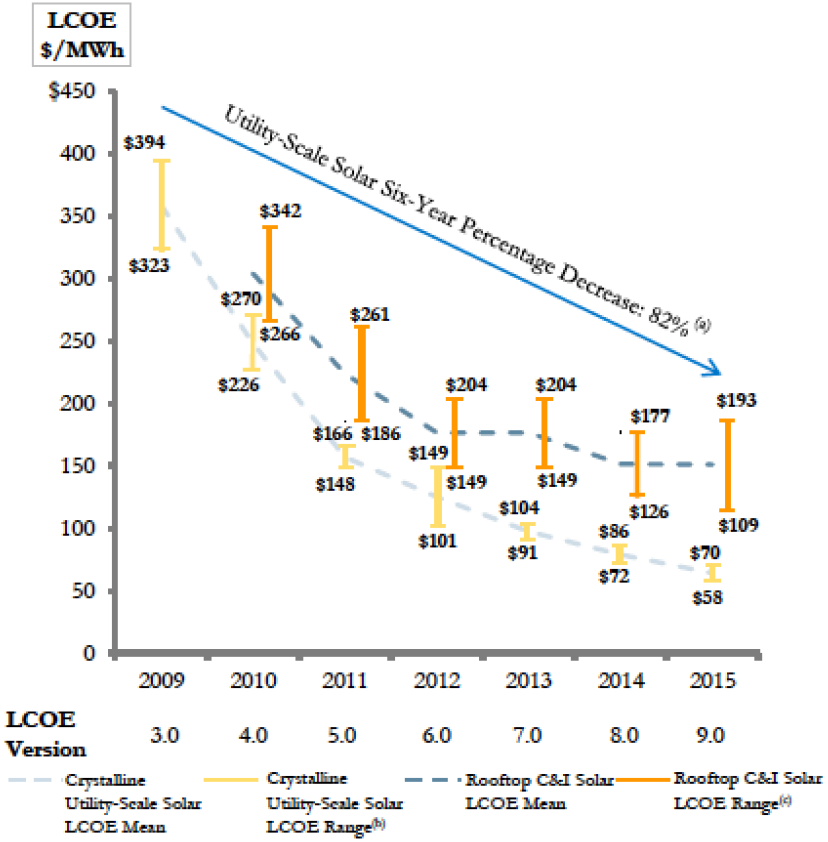
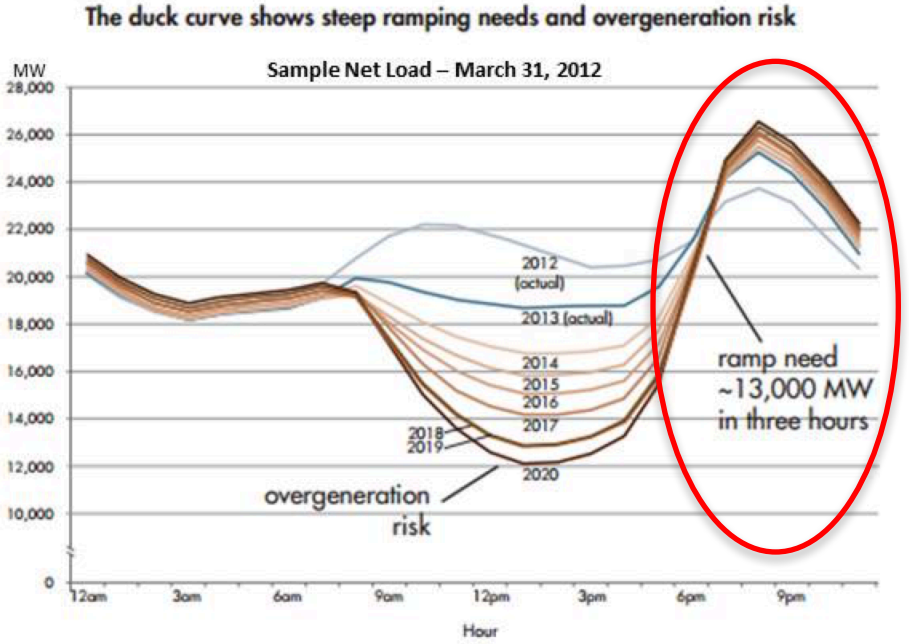
MARKET PLACES HIGH VALUE ON ABILITY TO RAMP

Solar PV LCOE have decreased ~80% in 6 years



Duck curves show requirement for steep ramping need



(from the California Independent System Operator)

Deregulated markets work to incentivize spot producers and dis-incentivize base-load

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FACTORS DEFINING "RAMPABILITY" FOR A NPP

Dynamic reactor core

- Neutronics permit fast power ramp up and down

Dynamic Balance-of-Plant

- Turbines are agile and can support fast ramp up and down

Financial dynamics

- NPP project has financial capacity to carry excess capacity

IMSR™ VALUE PROPOSITION TO HYBRID ENERGY SYSTEM

IMSR generates BTUs

- 600 °C BTUs in the form of a hot solar salt

Remoteness of Balance-of-Plant and BTU use

- Solar salt loop can extend up to 5km from nuclear island to Balance-of-Plant
- Non-nuclear grade use requirement

Cost-competitive BTUs

- Price competitive with NG over long run
- After NG volatility risk-adjustments potentially price competitive over the short run
- $50 per tonne CO2 policy scenarios
- High and better economic use for NG

Dispatchable BTUs

- IMSR™ can ramp fast

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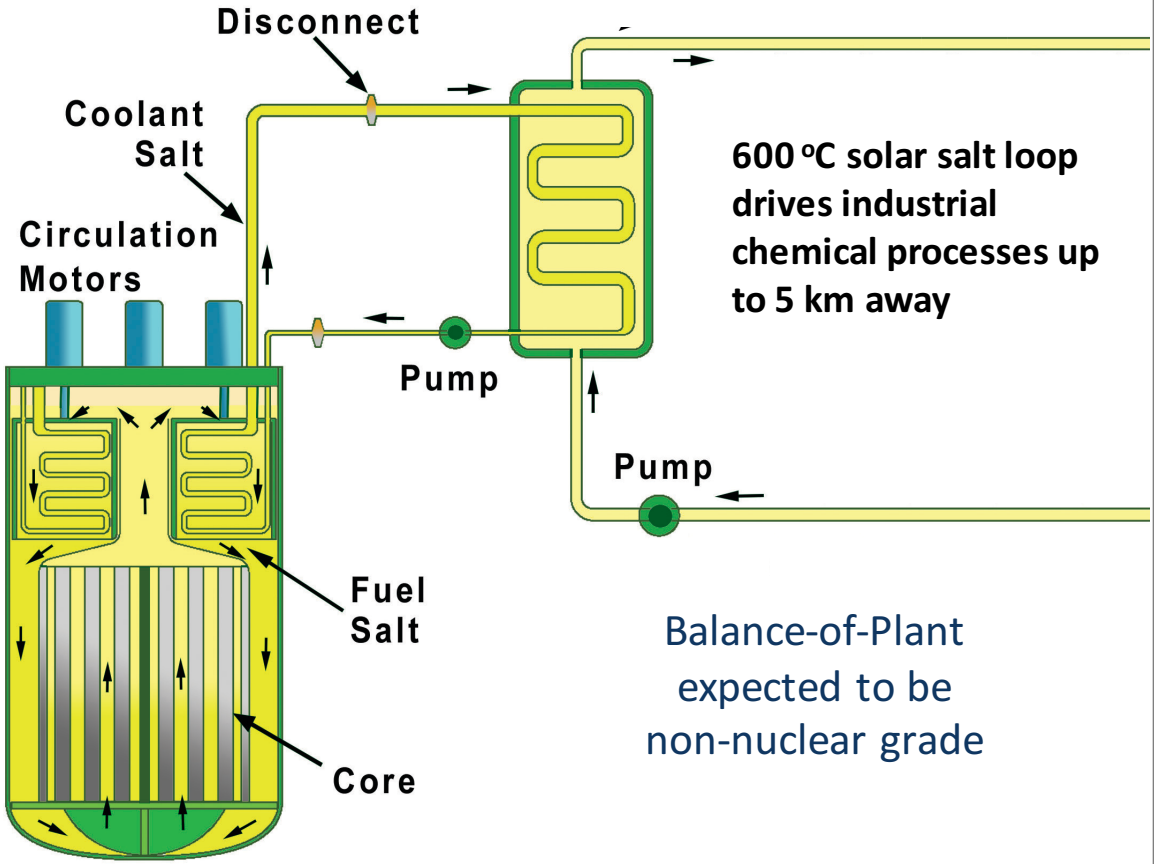
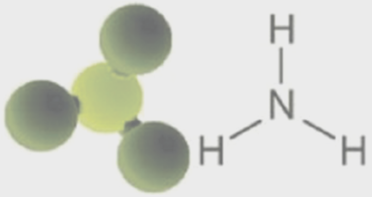
IMSR™ 400 MWth GENERALIZED THERMAL PLANT FACILITY



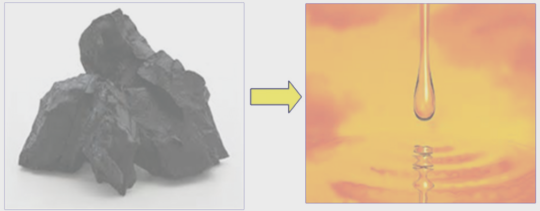
600 °C solar salt loop drives industrial chemical processes up to 5 km away

Balance-of-Plant expected to be non-nuclear grade

Nuclear Hydrogen and Oxygen



Ammonia



Coal to liquids

For industrial heat applications

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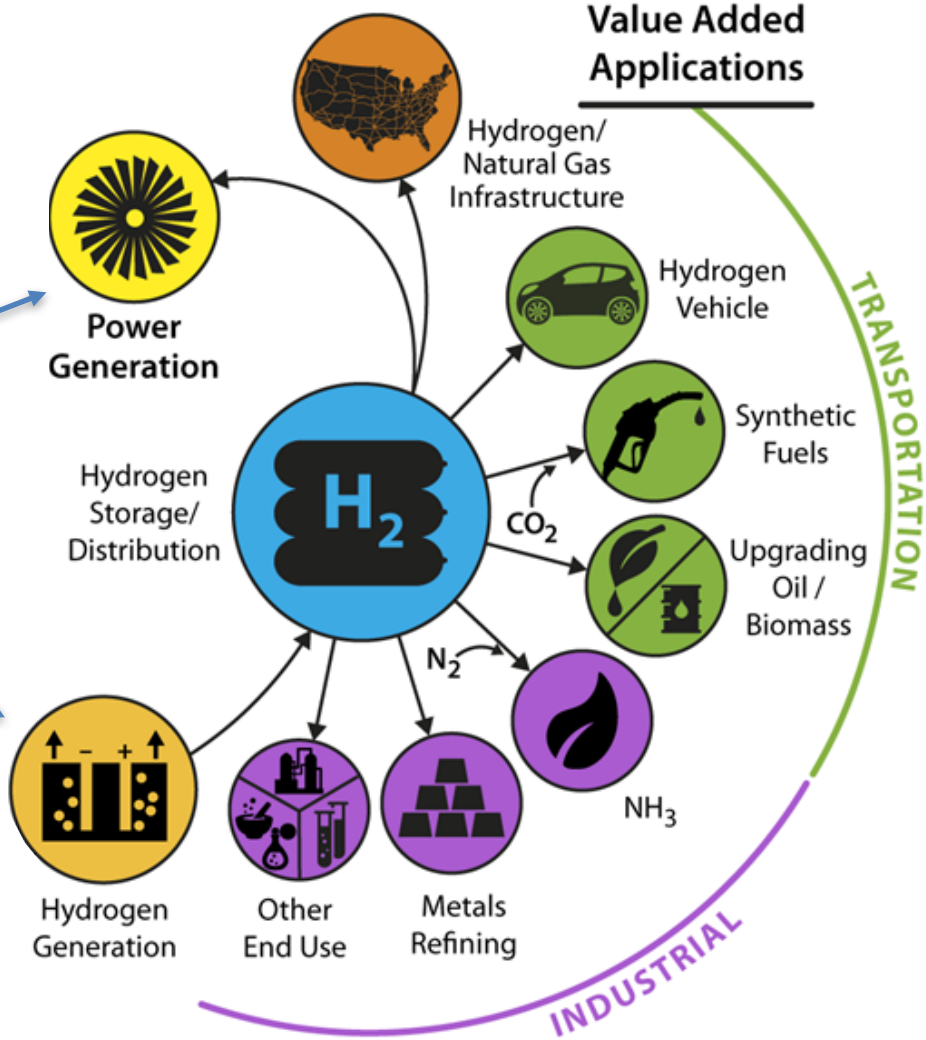
IMSR ENABLES TOMORROW'S CLEAN GLOBALLY COMPETITIVE INDUSTRY

Industry produces >20% of U.S. GHG emissions
And fuel refining produces ~5%

IMSR™ is dispatchable industrial heat



IMSR™ can play a central role in a decarbonized primary energy system

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TERRESTRIAL ENERGY INC'S CORPORATE INDUSTRIAL ADVISORY BOARD

Power Utilities

- Energy Northwest operates the Columbia Generating Station, located in Richland, Washington, USA.
  - Represented by Mark Reddemann, Chief Executive Officer
- Ontario Power Generation owns and operates the Pickering and Darlington Nuclear Power Stations in Ontario, Canada.
  - Represented by Jeff Lyash, President and Chief Executive Officer
- PSEG Nuclear operates the Salem and Hope Creek Nuclear Generating Stations in Lower Alloways Creek, New Jersey, USA, and is a part owner of the Peach Bottom Nuclear generation station in Delta, Pennsylvania, USA.
  - Represented by William Levis, President and Chief Operating Officer of PSEG Power.
- Southern Nuclear Operating Company operates the Alvin W. Vogtle Electric Generating Plant near Waynesboro, Georgia, USA, and the Edwin I. Hatch Nuclear Plant near Baxley, Georgia, USA, and the Joseph M. Farley Nuclear Plant near Dothan, Alabama, USA.
  - Represented by Stephen Kuczynski, Chairman, President and Chief Executive Officer.

Industrial

- Caterpillar is the leading manufacturer of construction and mining equipment, diesel and natural gas engines, industrial gas turbines and diesel-electric locomotives.
  - Represented by Dan Henderson – Director of Research and Advanced Engineering.

TERRESTRIAL ENERGY INC'S ADVISORY BOARD

Technical

- Paul Blanchard, PhD – Former Strategic Communications Consultant for NASA
- J. R. (Dick) Engel – Chief Engineer of MSRE at ORNL
- Ray O Johnson, PhD – Former CTO of Lockheed Martin Corporation

Power Utility and Industrial

- Thomas Drolet – Former President, CEO of Ontario Hydro International
- James Reinsch – Director of ENEC and OPG. Former President of Bechtel Nuclear

Regulatory

- Julian Kelly, PhD – CTO, Thor Energy. Former Australian Nuclear Attaché to IAEA.
- Jeffrey Merrifield, JD – Former NRC Commissioner and former SVP Shaw Group
  - Legal Counsel to Advisory Board
- Nabila Yousef – Former Engineering Director at Pickering Nuclear Power Plant

Environmental

- James Cameron – Former Chairman of Climate Change Capital
- Travis Bradford – Professor (energy and natural resource markets, and innovation), SIPA, Columbia University
- Ben Heard – Professor, Clean Energy Systems, University of Adelaide
- Christine Todd Whitman – Former Governor of New Jersey and Head of the US EPA

Financial

- Robert Litterman, PhD – Former head of risk at Goldman, Sachs & Co.

SUMMARY

Growing market demand for energy innovations that "change the game" – driven by escalating demands for scalable clean energy solutions for all industry, not just the grid

Unique Safety Case of IMSR™ supports commercially critical cost-innovation

- Potential to dispatch heat and power at life-of-plant costs that are competitive with fossil fuel alternatives

IMSR™ produces 600°C BTUs in the form of a hot solar salt

- Applicable to many industries
- Balance-of-plant is remote and IMSR BTU use is expected to be a non-nuclear activity

IMSR™ has a high level of technology readiness

- No substantive technical issues remain
- Ordinary detailed nuclear engineering work required for IMSR™ commercialization
- Started nuclear regulatory process with CNSC
- First Commercial Plants in the 2020s

IMSR™ can play an important role in the deep decarbonization of our primary energy system

CONTACT DETAILS

THANK YOU!

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